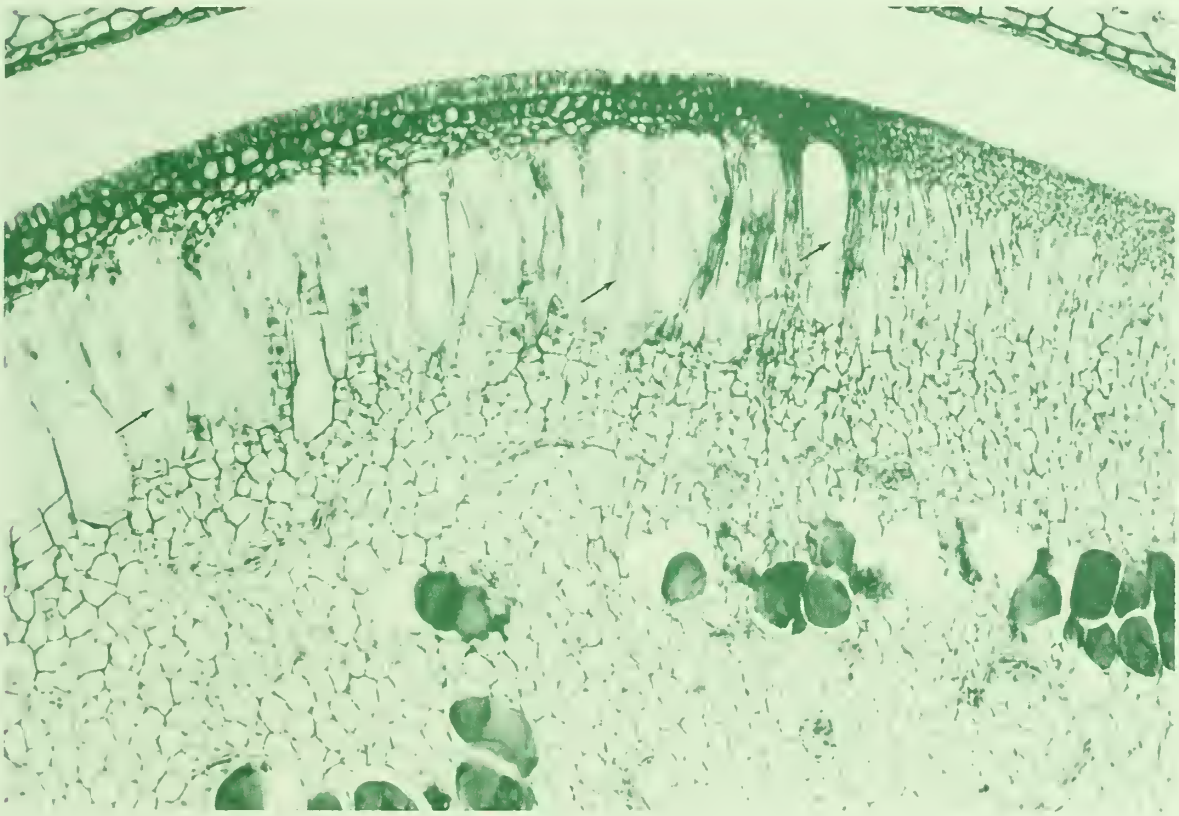
REPORT OF

FORTY-FIFTH ANNUAL

DATE GROWERS' INSTITUTE



DATE FRUIT

HELD IN

COACHELLA VALLEY, CALIFORNIA

April 27, 1968

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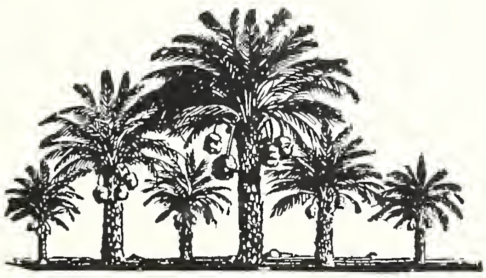

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FRANK WILSON

Manager, Shields Date Garden
Indio, California

Chairman Afternoon Session

WALTER REUTHER

Professor of Horticulture
Department of Horticultural Science
University of California, Riverside

COVER: Longitudinal section of 2.5 mm diameter Deglet Noor date fruit (X175) collected April 10, 1968 at Indio, California showing differentiation of thick-walled stone cells (arrows). Differentiation progresses from the stylar end toward the stem end. The photomicrograph was taken near the equatorial region with the stem end toward the right. Tannin deposits, some of which were displaced during preparation of the tissue, are shown in the lower portion of the photograph. The upper portion includes parts of a petal.

C. W. Coggins, Jr. and Alice L. Ricker, University of California, Riverside

CORRECTION OF BARHEE BENDING BY BUNCH HANDLING PRACTICES

LELAND J. YOST

Thermal, California

The Barhee, a very minor variety in Coachella Valley's overall date picture, has not received much study and only a few growers have had much experience with it.

We have a garden which includes 10 acres of Barhees. After a few seasons the tops of some of the trees were obviously bending in the direction of the fruit load.

Roy Nixon suggested that the fruit stems be arranged to hang the fruit load opposite the bend. Leonhardt Swingle disclosed that his Barhee planting had developed the same top bending and that he had corrected it by bunch placement. So we adopted his practice.

Barhees have a long, heavy fruit stalk, which can be rearranged quite easily. After pollination the husk of the spathe was cut off and jammed between the base of the stem and the trunk of the tree to direct the stem in the desired direction as it grows. At tie-down time the placing of the stems is completed.

This procedure has been quite successful, in fact, too much so in some cases. Some trees have been over-corrected and are starting to bend in the opposite direction. We hope this year, by rearranging the fruit load to bring the tree top back to vertical.

Why some Barhees bend at the top I do not know. However, at this moment I think the condition can be corrected by the simple steps I have outlined.

POST-HARVEST SOFTENING STUDIES OF DEGLET NOOR DATES: PHYSICAL, CHEMICAL AND HISTOLOGICAL CHANGES[1]

C. W. COGGINS, JR., J. C. F. KNAPP, and ALICE L. RICKER

Department of Horticultural Science
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In a previous paper (1) we reported chemical and histological studies of various stages of maturity and various grades of Deglet Noor dates. Our results for moisture, reducing sugars and sucrose among stages of maturity and grades of dates were in close agreement with previous reports (3, 4, 5, 6, 7). We also reported that substantial decreases in pectin, hemicellulose, and cellulose were seen among various stages of maturity, but most of these changes occurred between the kimri (turgid and green) stage and the first stage of softening. No clear differences in these polymers were seen between the dry (firm) and natural (soft) grades. Thus, chemical assay of polymer fractions did not explain textural differences found among grades.

Histological studies (1, 2) of different stages of maturity have shown that a considerable loss of cell wall structure occurs during ripening. Firm grades have a structure similar to immature stages, as far as intact cell walls are concerned, while many cell walls in soft grades are ruptured (1). It appears, therefore, that histological studies provide a clear understanding of textural differences based on structural strength.

Recent studies, reported in this paper, have been devoted to 1) chemical analyses of outer and inner mesocarp tissue of firm and soft grades, 2) attempts to soften the firm dates, 3) a preference study of softened versus naturally soft dates, 4) a study of histological changes that occur during the post-harvest softening process and 5) an attempt to determine whether firm dates are located on a particular portion of the strand.

CHEMICAL STUDIES

The hypothesis that the dark-colored outer mesocarp and the light-colored inner mesocarp may differ with respect to sugars and other constituents, and that differences may provide information important to an understanding of texture, was evaluated. The results of chemical analyses of these two zones of samples of Number 1 Dry dates and Natural dates are presented in Table 1.

TABLE 1. Chemical analyses of outer and inner mesocarp tissues of Natural and Number 1 Dry Dates.

Component[1]	Natural		No. 1 Dry	
(% — dry wt. basis)	Outer %	Inner %	Outer %	Inner %
Glucose	14.4 a	13.0 b	10.7 c	7.7 d
Fructose	17.9 a	16.1 b	13.8 c	10.5 d
Sucrose	50.0 d	58.7 b	55.0 c	69.9 a
Total Sugars[2]	82.3 b	87.8 a	79.5 b	88.1 a
Alcohol Soluble Solids	87.1 b	91.7 a	86.7 b	91.1 a
Low Methoxyl Pectin	1.3 b	2.2 a	1.4 b	2.1 a
High Methoxyl Pectin	0.7 b	0.9 a	0.5 b	1.1 a
Protopectin	1.7 b	2.2 a	1.8 b	2.5 a
Total Pectin	3.7 b	5.3 a	3.7 b	5.7 a
Lignin	0.3 a	0.1 b	0.3 a	0.1 b
Hemicellulose a[3]	1.5 a	0.9 b	1.7 a	0.8 b
Hemicellulose b[4]	0.8 a	0.9 a	0.8 a	1.0 a
Total Hemicellulose	2.3 a	1.7 b	2.6 a	1.8 b
Cellulose	0.8 b	1.1 a	0.9 b	1.2 a

[1] Average of 3 extractions. Means in the same row followed by different letters are statistically different at the 5% level.

[2] Ratio of reducing sugars to sucrose in mesocarp: Natural, outer 0.64, inner 0.50; Number 1 Dry, outer 0.45, inner 0.26.

[3] Extracted with dilute base.

[4] Extracted with concentrated base.

When the same zones of the 2 grades were compared, the only differences seen were in relative amounts of reducing and non-reducing sugars. These results agree with previous comparisons where the 2 zones were not separated. Within a grade, interesting differences were seen beween the inner and outer mesocarp tissue. For both grades, the outer mesocarp contained higher levels of reducing sugars, lignin, and the hemicellulose fraction extracted with dilute base. The inner mesocarp was relatively rich in sucrose, total sugars, alcohol soluble solids, pectin fractions, and possibly cellulose.

The relatively low total sugars and relatively low alcohol soluble solids found in the outer mesocarp may be a reflection of the high level of condensed tannins present in the outer mesocarp (a dilution effect), but the higher ratio of reducing sugars to sucrose in the outer mesocarp was probably a reflection of a greater degree of inversion in the outer mesocarp, as well as a much greater degree of inversion in the Natural than in Number 1 Dry date tissue.

The inner mesocarp of the Number 1 Dry date had a much lower ratio of reducing to non-reducing sugars than any other tissue considered. These results suggest that inversion either starts later or proceeds slower in the inner mesocarp than in other tissues. If we assume that inversion is important during the post-harvest softening, and if we assume that hydration is necessary for inversion, then it seems important to use hydration procedures that will effectively deliver moisture to the inner mesocarp tissue.

An infiltration procedure has been used for many years to hydrate firm dates. This procedure is not widely used by the date industry and differs from the pro-

[1]Report of work done under Contract No. 12-14-100-8871(74) with the U. S. Department of Agriculture. The contract is supervised by the Western Utilization Research and Development Division, Agricultural Research Service.

cedures used in the studies reported here. Our system provides a rapid introduction of moisture under conditions where the inner portion of the inner mesocarp becomes waterlogged. Subsequent to infiltration, excess moisture in the innermost layer migrates throughout the tissue as an equilibrium condition is established.

Number 1 Dry textured dates were moistened by vacuum infiltration and then incubated at 25° C for 0, 24, 48, and 72 hr. After incubation, the inner and outer mesocarp tissues were separated, and the tissues were subjected to the same series of analyses reported in Table 1. Significant changes were restricted to reducing and non-reducing sugars; reducing sugars increased while non-reducing sugar levels decreased. While this is a well known change, the results of this study showed that the fastest and largest changes, by far, occurred in inner mesocarp tissue. Most of the inversion had occurred during the first 24 hr.

It is interesting that the only clear chemical differences reported for Natural and Number 1 Dry dates were the only kinds of chemical changes found during postharvest softening of firm dates.

SOFTENING STUDIES

All of our softening studies have involved vacuum infiltration of water, or water plus enzymes, followed by incubation in sealed containers. Subsequent to incubation, pits were removed and the force required to shear the tissue was measured. A sample consisted of 10 sub-samples of 3 dates each. Data are presented in Tables 2, 3, and 4.

Softening of Number 1 Dry dates, as measured by shear force, appeared to occur rapidly, even at 35°C. The simple addition of water (zero incubation time) decreased shear force substantially. This response was probably associated with the reduction of friction as well as solubilization of some of the sugars. At this stage in the process, the innermost layer of tissue was waterlogged. During the 2 hr incubation period, water appeared to become uniformly distributed throughout the fruit, thus it is possible that some of the softening during the first 2 hr was associated with the same factors responsible for softening seen at zero time.

At 35°C incubation, the dates were as soft as Natural dates (6.2 lb. shear force per g) within 4 to 7 hr. At 70°C shear force of the Number 1 Dry grade had dropped to the level of Natural dates within 2 hr. It is possible that infiltration at 29 inches vacuum for 15 min was slightly superior to 15 inches for 5 min, but in general, the later condition appears to be adequate. We should point out that the infiltrated dates contained ap-

TABLE 2. Softening of Number 1 Dry dates following vacuum infiltration with water. Avg shear force in lb. per g fresh wt (wt before water infiltration).

Softening Procedure	Not infiltrated	Incubation time, hr							
		0	2	4	7	9	11	28
15 inches vacuum for 5 min. Incubation at 35°C	16.4	10.0	7.3	6.4	5.0	4.5	4.1	3.8
	Not infiltrated	0	2	4	6			
29 inches vacuum for 15 min. Incubation at 35°C	16.9	11.0	6.5	5.1	4.2			
	Not infiltrated	0	2	4	6			24
29 inches vacuum for 15 min. Incubation at 70°C	18.0	11.2	4.3	3.2	3.1			2.8

TABLE 3. Softening of Number 2 Dry dates following vacuum infiltration with water. Avg shear force in lb. per g fresh wt (wt before water infiltration).

Softening procedure	Not infiltrated	Incubation time, hr				
		0	2	4	6	24
29 inches vacuum for 15 min. Incubated at 35°C	21.5	14.4	9.6	8.3	8.1	6.1
29 inches vacuum for 15 min. Incubated at 50°C	20.6	13.0	7.8	3.2	4.8	3.3
29 inches vacuum for 15 min. Incubated at 60°C	20.6	11.7	6.4	3.9	3.7	2.8
29 inches vacuum for 15 min. Incubated at 70°C	18.6	12.2	4.8	3.4	3.9	- -

TABLE 4. Softening of Number 2 Dry dates following vacuum infiltration with water plus enzymes. Avg shear force in lb. g fresh wt (wt before water infiltration).

Softening procedure	Not infiltrated	Incubation time, hr				
		0	2	4	6	24
29 inches vacuum for 15 min, 1% pectinase in water. Incubated at 35-40°C	18.4	14.8	10.6	8.6	6.9	4.6
29 inches vacuum for 15 min, 0.5% cellulase in water. Incubated at 35-40°C	17.0	13.8	9.5	7.1	7.5	4.0
29 inches vacuum for 15 min, 0.5% hemicullulase in water. Incubated at 35-40°C	20.1	16.0	9.4	7.7	7.1	5.0

proximately 31% moisture. This relatively high level of moisture may contribute to the low shear forces seen and we have found that a reduction of moisture subsequent to a given incubation period causes shear forces to increase.

Data for Number 2 Dry dates are reported in Table 3. Although higher incubation temperatures were associated with faster softening, it appeared that 50°C was adequate for rapid softening (4 hr incubation period). Higher temperatures caused the development of a reddish color which is undesirable. This color was associated with the tannins.

The addition of pectinase, hemicellulase or cellulase to the infiltration water appeared to have no influence on rate of softening (Table 4.) If these enzymes are active in softening subsequent to hydration, we must assume that our conditions were not satisfactory for enzyme activity or that a sufficient supply of these enzymes was present in the tissue.

Although we recognize that date fruits are not simple gels, we must recognize that chemical composition, as opposed to anatomical features, may contribute substantially to differences in firmness of dates.

Two gels were prepared in which sucrose, glucose, fructose, pectin, and moisture levels were equivalent to Natural and Number 2 Dry grades. The gel simulating Number 2 Dry dates was much firmer than the gel simulating Natural dates. These results suggest that chemical differences, as such, contribute to textural differences, and these results may explain why the addition of invertase hastens the softening of firm dates (3).

FRUIT PREFERENCE STUDIES

Two preference tests have been conducted where Natural dates were compared to softened Number 2 Dry dates. The first test suggested that men prefer a somewhat firmer textured fruit than do women. In a second test, Number 2 Dry dates were vacuum infiltrated with water and incubated at 50°C for 2 and 4 hr. These 2 samples, as well as a sample of Natural dates, were presented to 75 women. The samples were presented as numbered samples and the tasters were asked to place the samples in order of preference. In most cases a definite preference was listed by the individual taster, but no significant differences existed when the results from all tasters were tabulated. This does not say that the treatment converted Number 2 Dry dates into something that cannot be distinguished from the Natural grade, but the results suggest that softening treatments can give an acceptable product. The results also suggest that Natural dates may not be the ultimate choice with respect to consumer acceptance or preference.

HISTOLOGICAL STUDIES

Histological studies were made on Number 2 Dry dates subjected to 50 C incubation after infiltration with water at 29 inches vacuum for 15 min. Some cell wall breakage or dissolution had occurred by 4 hr. This condition increased with time until extensive dissolution was present at the end of 24 hr incubation (Figure 1). The condition at 24 hr was similar to Natural dates. Although shear-force data suggest that the dates were as soft as Naturals by the end of 4 to 6 hr, histological studies indicate that cell walls were not similar to Naturals until a longer period of incubation was used.

Chemical studies have shown (Table 1) that lignin is more abundant in the outer mesocarp than the inner mesocarp. Although the amount of lignin is low, even in the outer mesocarp, and may not be meaningful in explaining textural differences, the localization of lignified tissue is of interest. According to 2 histochemical tests, lignin was found in the walls of vessel members and in the thick-walled stone cells. While vessel members occur throughout the mesocarp, stone cells are restricted to the outer mesocarp. Thus, the higher amount of lignin found in the outer mesocarp was due to the presence of stone cells. Although these histochemical tests cannot be used to detect lightly lignified tissue, they certainly indicate that the

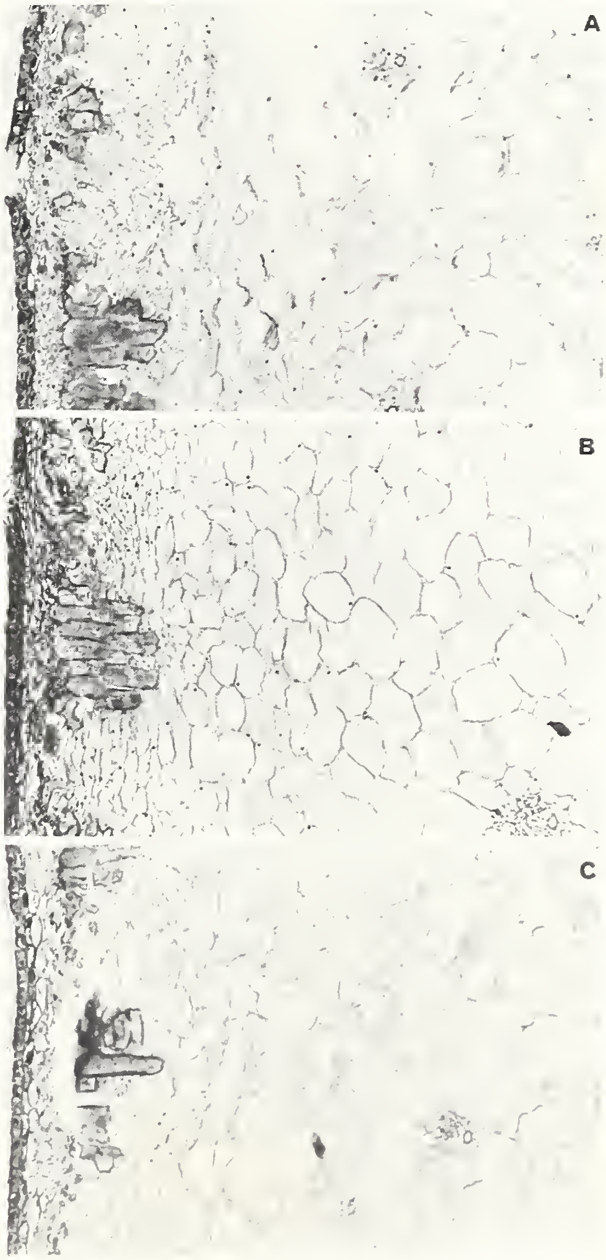

FIGURE 1. Transections from equatorial zone of Deglet Noor date fruits (X 110). A = Soft grade. B = Firm grade. C = Firm grade infiltrated with water and incubated for 24 hr at 50 C. Note intact cell walls in B and evidence of cell wall dissolution in A and C.

bulk of lignification involved the 2 types of cells mentioned. Some scattered, large, thick-walled structures, which we have not studied in detail, occur in the inner mesocarp. These cells may contain small amounts of lignin in the wall. The walls of these cells are approximately as thick as vessel member walls and considerably thinner than the walls of stone cells.

We have been impressed with the numerous "fiber-like" strands present in date fruit tissue. These are vascular bundles and are numerous when the date is viewed in cross section under the microscope. A preliminary study of the number and size of bundles indicates that more than 500 bundles are present in the cross section of a fruit. Many of these bundles are large enough to be seen with the naked eye.

LOCATION OF FIRM DATES ON STRANDS

A small study was undertaken to determine whether firm dates occur in a particular location on the strand and to determine whether a relationship exists between stage of development at a particular time and the texture at a later time.

One large bunch was selected and individual strands, as well as individual dates on each strand, were identified on October 1, 1967. The dates were evaluated for color (red-green, tan, light-brown, and dark-brown). One month later, the dates were rated for texture and the following relationships were found. Sixty per cent of the firm dates had been red-green on October 1, 36% had been tan, and 4% had been light-brown. These firm dates were evenly distributed along the length of the strand.

This study suggests that dates which were in a relatively "immature" condition on October 1 were subjected to rapid desiccation and became Number 1 and Number 2 Dry dates. This observation adds to the circumstantial evidence in the literature that firm dates are "immature" dates which have lost moisture too rapidly for "ripening" to occur. Our histological studies provide direct evidence that the development of the dry date has been arrested at an abnormally early stage.

DISCUSSION

Our research, along with a study of the literature, shows that large differences in moisture, ratio of reducing to non-reducing sugars, and anatomical features exist between the firm and soft grades of Deglet Noor dates.

It may be worthwhile to consider the concept that dates are mature, in relation to other fruits, at the first indication of softening, and that further changes, which lead to the various grades, are degenerative processes. If the concept is valid, it follows that the extent of degeneration would determine whether desirable soft grades are obtained.

The extent of degeneration would depend, to a large extent, on enzymatic processes. The degree to which degeneration occurs would then depend on favorable conditions for these reactions. If moisture were to fall below a suitable level before degeneration had progressed very far, the resulting dates would be firm. Some evidence exists in the literature that such dates would have a low water content in equilibrium with a given relative humidity, and thus be relatively dry dates (3).

The reason some dates are firm at maturity is that they dry too rapidly to permit the enzyme action required to complete degeneration of the tissues. We suggest that if a date reaches the stage of degeneration at a time when the strand is still green and able to supply moisture fast enough to keep moisture levels relatively high, degeneration proceeds to a suitable level. On the other hand, if a date reaches the degeneration stage at a time when the strand begins to wither, degeneration is hampered and a firm date is the end result.

Thus, it is reasonable to assume that post-harvest attempts to soften dates should be successful if all, or a significant portion, of the enzymes responsible for degeneration become active.

LITERATURE CITED

1. Coggins, C. W., Jr., L. N. Lewis, and J. C. F. Knapp. 1967. Progress report: chemical and histological studies of tough and tender 'Deglet Noor' dates. Date Growers' Inst. Ann. Rept. 44: 15-16.
2. Long, E. M. 1943. Developmental anatomy of the fruit of the Deglet Noor date. Bot. Gaz. 104: 426-436.
3. Maier, V. P. and D. M. Metzler. 1961. Sucrose inversion in Deglet Noor dates and its processing application. Date Growers' Inst. Ann. Rept. 38: 5-8.
4. ———, ———, and A. F. Huber. 1964. Effects of heat processing on the properties of dates. Date Growers' Inst. Ann. Rept. 41: 8-9.
5. Rygg, G. L. 1946. Compositional changes in the date fruit during growth and ripening. U. S. Dep. Agr. Tech. Bull. 910. 51 p.
6. ———. 1948. Acidity in relation to quality of the date fruit. Date Growers' Inst. Ann. Rept. 25: 32-33.
7. Sievers, A. F. and W. R. Barger. 1930. Experiments on the processing and storing of Deglet Noor dates in California. U. S. Dep. Agr. Tech. Bull. 193. 24 p.

THE INFLUENCE OF TEMPERATURE ON GERMINATION OF DATE POLLEN

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In large scale tests of aerial pollination of the date palm *(Phoenix dactylifera L.)* in the spring of 1967, the erratic and, in some gardens, poor set of fruit aroused considerable interest in factors that may influence pollination and fertilization of date flowers. The fact that abnormally cool weather occurred in the Coachella Valley during part of the pollination period suggested that adverse effects of the cool weather on pollen germination and tube growth and subsequent fertilization of the flowers might have caused the poor fruit set. Reuther and Crawford (2) covered date inflorescences with brown paper bags at time of pollination. This procedure markedly improved fruit set if air temperatures were abnormally low for several days immediately following pollination. They also found that date pollen germinated much more quickly at 85°F than at 60°F.

Growers asked us to investigate some of the factors that seem to influence fertilization and set of date fruit, especially the influence of temperature on percentage and rate (per cent per hr) of pollen germination. This paper reports the results of a study of germination of date pollen in culture solution under conditions of controlled temperatures.

MATERIALS AND METHODS

The pollen used in the germination tests was obtained from one large inflorescence, which was cut and taken to the pollen drying room as soon as the spathe cracked. The pollen was shaken out as the anthers dehisced, spread into a thin layer on large sheets of paper, rapidly dried, transferred to a stoppered bottle and stored in the refrigerator. Pollen needed for germination tests was suspended in modified Brewbaker and Kwack (1) culture solution at a concentration of 0.1 g of pollen per 100 ml of solution. The stock culture solution was made up with the following chemicals per liter of deionized water:

H_3BO_3	0.5 g
$Ca(NO_3)_2 \cdot 4H_2O$	0.3 g
$MgSO_4$	0.2 g
KNO_3	0.1 g
Na_2Mn[a]	0.1 g

To this solution 15% (w/v) of sucrose was added just before culturing the pollen. After a few min allowed for the pollen to become wet and dispersed in the culture medium, 3 to 5 ml of the suspension were pipetted into 125-ml Erlenmeyer flasks, which were then stoppered. Just enough culture medium was added to cover the flask bottom with a thin layer through which oxygen might diffuse rapidly enough to supply the suspended pollen with adequate oxygen for germination and growth. During germination tests the flasks were placed in an incubator with temperature kept constant within ±1.8°F by a thermostatically controlled heating element. One incubator was operated at temperatures of 80°F and above, and another in a walk-in refrigerator was operated at temperatures below 80°F. Maintaining the refrigerator at suitable temperature levels below the settings of the incubator made it possible to use the incubator to maintain close temperature control down to 38°F, the lower end of the temperature range of these tests.

We incubated 5 replicate cultures on two different dates for each period of time at each temperature setting. When removed from the incubator, the flasks were immediately placed in a refrigerator at 30° to 36°F to stop further germination until the pollen could be examined. From each flask a drop or 2 of the pollen suspension was placed on 2 microscope slides for examination under low power (100X) of the microscope. One hundred pollen grains on each slide were observed and the number germinated recorded on a mechanical counter. Thus, each germination percentage was based upon a count of 2,000 pollen grains.

The first germination tests (series 1) were conducted for periods of 2, 4, 6, 8, 12, 16, 24 and 48 hr and at temperatures of 45°, 52°, 60°, 72°, 80°, 90°, 100° and 110°F. Series 2 was conducted for periods of 10 min up to 100 min and at temperatures of 80° and 110°F.

Two sets of cultures in series 2 were incubated at 110°F. In one set (a) the pollen was suspended as usual in culture solution in flasks that were at room temperature (70° to 75°F) before they were placed in the incubator; in another set (b) pollen was suspended in culture solution and flasks that were preheated to 110°F, so that from the start of swelling the pollen was subjected to 110°F.

We conducted another series of tests (series 3) at 110°F to observe the effect of enrichment of the atmosphere with oxygen on germination. We placed one set of flasks in polyethylene bags and added oxygen gas to the bags until the atmosphere was estimated to be about 50% oxygen. The bags containing control cultures were filled with normal air of 20% oxygen (by volume). To allow diffusion of oxygen into the flasks, we left them unstoppered. To reduce evaporation of water from the culture solution, we placed wet paper toweling in the bags. In these tests the flasks were at room temperature when placed in the incubator and they were incubated for 2 or 4 hr.

RESULTS AND DISCUSSION

In series 1 the date pollen in culture solution at 38°F for periods up to 96 hr showed no germination. In the temperature range 45° to 110°F, however, both percentage and rate of germination were greatly influenced by temperature during the first 2 to 8 hr of incubation (Fig. 1). After 24 hr at 45°F, germination was 0.05% and after 48 hr, 0.3%. At 52°F germination increased, but was still only 22% after 24 hr. Why germination did not increase further in 48 hr is not apparent. In a repetition of the test, germination after 48 hr was no better than after 24 hr. At 60°F the percentage of germination in each period was greatly improved, being 63% in 24 hr, but the rate at which germination occurred in the first 2 hr was still about 1/4 that at 72°F and slightly less than 1/6 that at 80° to 100°F. At 72°F the percentage of germination in the first 2 hr was well below that at 80° to 100°F. After the first 4 hr, however, the percentage of germination at temperatures from 72° to 100°F differed

[a] Active ingredient of manganese chelate: technical disodium manganous ethylenediamine tetraacetate dihydrate.

little. The maximum percentage of germination (88%) was attained at 80°F after 24 hr. At 110°F in series 1 only about 50% of the pollen germinated regardless of time period, and even during the first 2 hr germination rate was lower than at 72° to 100°F. At the high temperture range, 72° to 110°F, the germination counts after 48 hr were actually lower than during shorter periods. This discrepancy in germination counts of cultures incubated at high temperatures for long periods apparently resulted from the bursting of pollen tubes and the dispersal of their contents in the culture solution, which caused the disappearance of some of the pollen tubes from the field of observation.

In series 2, germination tests conducted at 80° and 110°F, and at intervals of 10 min showed that at those temperatures germination began within 20 min of the time the pollen was placed in the culture solution (Fig. 2). The highest rate of germination at 80°F was during the 20 to 30 min interval and at that temperature the rate was much higher during the first 50 min than during the second 50 min period.

In series 2, in which cultures were incubated at 110°F, the germination rate of pollen in the set (a) of cultures suspended in flasks initially at room temperature was high during the first hr, at the end of which 40% of the pollen had germinated (Fig. 2). In one interval, 10 to 20 min, the rate exceeded that at 80°F, but during the last 40 min germination in this set of cultures increased only 2%.

When cultures were preheated to 110°F and incubated at that temperature (set b) germination percentage and rate were both low (Fig. 2). The maximum of about 10% germination was attained in 50 min. After that the percentage of germinated pollen appeared to decrease because of bursting and disintegration of the pollen tubes.

In the tests of series 3, conducted to determine the effect of enrichment of the atmosphere with oxygen on germination at 110°F, germination in cultures with added oxygen after 2 and 4 hr incubation periods was 40% and 58%, respectively; and in controls in an atmosphere of normal air germination after 2 and 4 hr was 42% and 57%, respectively. Because of the lowering of solubility of oxygen in the culture solution with rising temperature, it seemed possible that oxygen deficiency might have caused the poor germination at 110°F. The results, however, indicate that oxygen deficiency was not an important factor in the reduced germination at 110°F.

In an effort to account for the poor germinatin of pollen incubated at 110°F in preheated flasks versus that in flasks not preheated (Fig. 2, curves (a) and (b)), we

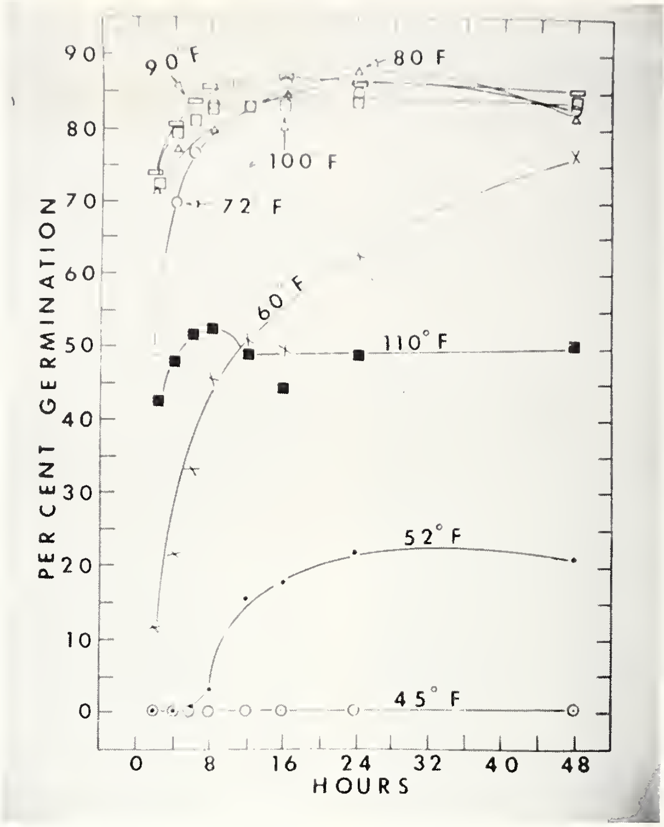

Fig. 1. The influence of temperature on germination of date pollen in culture solution for periods of 2 to 48 hr.

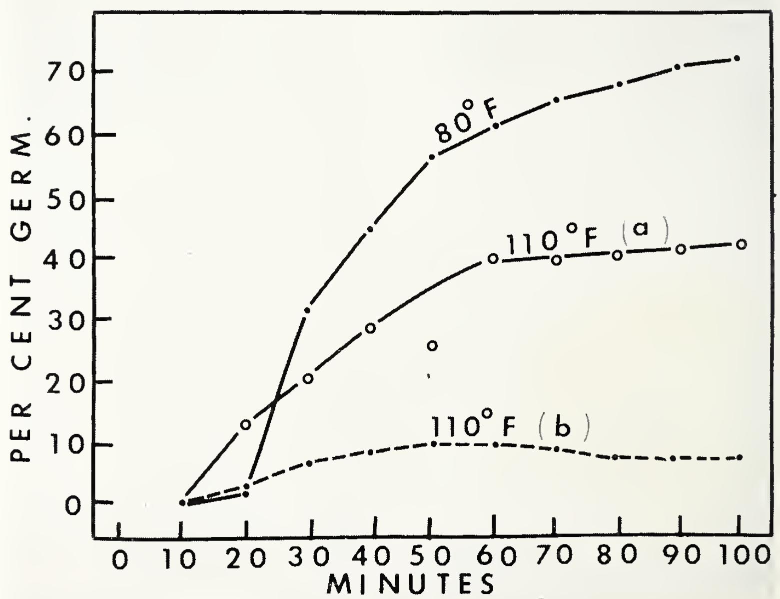

Fig. 2. The influence of temperature on percentage of germination of date pollen in culture solution during periods of 10 to 100 min. Curve (a), germination in culture flasks that were at 75°F when placed in incubator at 110°F; curve (b), culture flasks preheated to 110°F before pollen was suspended in solution. Culture flasks at 80°F not preheated.

placed 20 empty flasks with an initial temperature of about 75°F in the incubator at 110°F. After periods of 28 and 45 min the temperature of the interior of the flasks was about 106° and 108.5°F, respectively. These results, indicating slow warming of the flasks from room temperature to 110°F in the incubator, in conjunction with the slight effect of enrichment of the atmosphere with oxygen on germination at 110°F, suggest that high temperature was the main deleterious influence on germination of the date pollen in the preheated cultures at 110°F.

CONCLUSIONS

In culture solution the rate (% per hr) of date pollen germination increased with rising temperature from 45° to 90°F. In the range of 72° to 100°F, about 50% to over 70% of the pollen used in this study germinated in 2 hr or less, and 80% or more of the viable pollen germinated in the first 4 hr. At 72°F germination percentage and rate were much higher than at 60°F, suggesting that the critical temperature for adequate date pollen germination lies between 60° and 72°F. At 110°F pollen germination and pollen tube development were seriously impaired by the direct effect of high temperature.

ABSTRACT

Tests of germination of date *(Phoenix dactylifera L.)* pollen were made in culture solution at controlled temperatures from 45° to 110°F. With increasing temperature from 45° to 90°F, germination rate increased but was greatly reduced at 110°F. At 80° to 110°F germination began in the first 20 min of incubation. In the range 72° to 110°F, 50% to over 70% of the pollen germinated within 2 hr, and 80% or more of the viable pollen germinated in 4 hr. The maximum germination rate was at 80°F in the 20 to 30 min period of incubation and the maximum germination percentage was 88, attained at 80°F in 24 hr. At 110°F germination percentage and rate were low and many pollen tubes burst; increasing the oxygen content of the atmosphere in culture flasks caused little improvement in germination.

LITERATURE CITED

1. Furr, J.R., and V. M. Enriquez. 1966. Germination of date pollen in culture media. Date Growers' Inst. Rept. 43:24-27.

2. Reuther, W., and C. L. Crawford. 1946. The effect of temperature and bagging on fruit set of dates. Date Growers' Inst. Rept. 23:3-7.

PRODUCTION AND MARKETING OF MEDJOOL DATES IN BARD, CALIFORNIA

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In 1945, Stanley Dillman described date management practices of the Bard area[1]. Since there has been no recent description of date growing at Bard, I will discuss its present condition and the production and marketing of Medjool dates.

All of Bard has an underground moving water table from 4 to 8 ft deep and because of this, about 20 acre inches of irrigation water are required annually. This water is used to wet the upper soil surface and to help decompose the manure applied as fertilizer. Because of the high water table Bard growers consider the location and environment ideal for the production of Medjool dates. Irrigation water costs $14.50 per acre per year. We are allowed 5 acre ft per year on heavy soil or 8 on sandy soil. Water used in excess of this limit costs $2.75 per acre ft.

The top soil, originally deposited by the Colorado River, is one to 5 or 6 ft deep and underlaid with sand. It varies in type from sand to silty loam to clay, the greater part being silty loam.

The first commercial date garden in Bard was planted by Al Collins and Stanley Dillman in 1933. It consisted of 27 acres of Khadrawy, Zahidi and Saidy, which have since been replaced with Medjools. The oldest remaining date garden, consisting of Zahidis, Khadrawys, and Dayris, was planted by Mr. Hagberg in 1934, and is now owned by May Johnson. It has a maximum production of 250,000 lb.

Stanley Dillman was the pioneer in Medjool date production in Bard. His great enthusiasm for the Medjool date and his influence have created an equal enthusiasm in other growers for the future of this variety. Bard's original source of Medjools was 24 offshoots received from Indio in 1944 by Dillman and Collins. Twenty-two of these palms remain today. They were the original source of the 140 acres of Medjools planted in Bard, and will continue to be the source for the anticipated 150 or 160 additional acres to be planted in the future.

There are many new plantings of Medjools in Bard, with about 110 acres of non-bearing Medjools and about 36 acres of producing palms. My estimate of producing acreage is probably a little high as many of the palms included were only 9 or 10 years of age and not quite in full production.

A few plantings of Medjools have been interset with citrus, and, for the most part, are doing well, but I think most future plantings will not be interset with citrus, especially since most young citrus plantings are and will continue for a while to be lemons on macrophylla root. This combination grows into a large tree in a short time and is not suitable for interplanting with Medjools.

Young date offshoots are wrapped in burlap to protect them from the sun when they are planted. The usual spacing is 30 ft x 30 ft. The offshoots get started quite well in sand, but as many as 90% or more have been lost in the heavy soils. At $15 a shoot such losses are expensive.

After a poor planting on our ranch, we developed a method that we felt would insure the survival of offshoots in heavy soil where the base of the new offshoots remained wet so long that fungi attacked them. The trimmed, newly-removed offshoots were dipped in a 50 gal drum containing ferbam, a fungicide. After the ferbam treatment several handfuls of premoistened peatmoss containing a root-initiating hormone were packed around the base of the offshoot, which was then wrapped in moistened burlap and set in the field. With this method we lost only 3 palms out of 250.

According to Stanley Dillman, who worked out a system of bunch management that growers in Bard follow today, pollination usually begins in February. Each inflorescence should be pollinated as soon as the spathe cracks. After finding a cracked spathe, the worker cuts the sheath off, separates the strands and squirts a little pollen into the center of the bunch. The strands are then tied together with string with a simple slip knot. The purpose of the string is to prevent the strands from tangling with the leaves and to indicate the pollinated bunches. As these bunches grow out, they are trained for direction with binder twine tied from the bunch to a leaf next to the place one wants the bunch to go. Mr. Dillman determined that 13 bunches per palm was the optimum number for Medjools.

When the fruit is about 3/16 inch in diameter, the center of the bunch is cut out leaving a ring of 25 to 35 strands around the outside. Then when the fruit is about ½ inch in diameter the strands are thinned to 13 fruit per strand. The fruit should be evenly spaced and the largest left on the strand. In August when the dates have become heavy enough to pull the bunch down to its permanent place, 14 gauge wire rings 8 inches in diameter are placed in the center of the bunches. As the fruit begins to ripen, bunches are covered with a muslin tube which measured flat is 33 x 58 inches, the top 27 inches being waterproofed. When placed over the bunch and tied at both ends, this bag protects the fruit from light rains, birds and insects. The bunches are not sprayed or dusted for insects or diseases. The use of these bags sometimes presents a problem. In 1967 Bard received 2 inches of rain followed by a 2-week period of about 90% humidity during date harvest. Under these conditions the bags did not keep the dates dry and later did not provide the ventilation needed for the water to evaporate off the dates. As a result, much of the crop was lost. It may be necessary in the future for growers to construct bags that allow better ventilation for the dates.

Each palm produces about 200 lb. of fruit. In the past this fruit was marketed through two outlets, one in Indio and the other in Phoenix, Arizona. Stanley Dillman supplied the Indio outlet. His facilities included a small packing shed and a cooling unit capable of storing a carload of dates packed in 15 lb. cardboard containers. Mr. Dillman also handled fruit from other date gardens in Bard. Mrs. Johnson sold her fruit in Phoenix. She simply picked the dates and shipped them field run. She has also sold some of her Medjools in Indio. These markets proved to be satisfactory for the small amount of dates produced in Bard in the past. However, the production will soon be too large for these outlets to handle. I have estimated the 1968 crop to be around 175,000 lb. or more. Within 6 to 7 years we will have approximately 140 acres in full production, or about 1,450,000 lb. Then with the 160 more acres

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[1]Dillman, R. S. 1945. Date management practices at Bard, California. Date Growers' Inst. Rep. 22:16-17.

to be planted in the near future our production may reach 3,000,000 lb. in 15 years. According to Stanley Dillman, if the dates are raised and handled properly, the grower should get approximately 84% No. 1 fruit (22 per lb. or larger), 4% smaller sizes and 12% culls. This means that in 15 years Bard may produce 2,500,000 lb. of No. 1 marketable Medjool dates. This amount far exceeds the capacity of our present outlets. In fact, our 1968 production exceeds present marketing outlets. Furthermore, we lack packing facilities to handle this amount. It is obvious that before the 1968 season the Bard date growers must set up a packing plant and develop their markets. However, at present there are several good possibilities for marketing outlets, and the growers feel that the future of Medjool date production in Bard is very promising. Given these markets and necessary handling facilities, Bard could easily become a major producer of high quality California Medjool dates.

EVALUATION OF THE EFFECTS OF MALATHION DUST APPLICATIONS FOR THE CONTROL OF DATE-INFESTING INSECTS

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The 1966 date crop in California had a high percentage of insect-infested fruit probably due to a combination of climatic conditions and mechanized harvesting procedures. Following a report on the need for better control of these date pests with malathion[1], the date industry, date growers, and the University of California in a cooperative effort designed a series of malathion dust tests to establish the frequency and timing of dust schedules to most economically reduce the losses attributed to these pests. Combined field-laboratory experiments were also conducted to gain further information on how long malathion dusts could effectively protect date fruit from these insect infestations.

Two date groves, each with 9 plots, were selected for commercial dusting tests. A 5% malathion dust was applied at the rate of 50 to 80 lb. per acre to each of the first 4 plots on August 15; this is earlier than date palms are normally commercially dusted for nitidulid beetle control. The fifth plot was left as an untreated check. The other 4 plots were then dusted 2 weeks later. Certain plots were re-dusted at 3-week intervals so that at the completion of the dusting program, October 30, plots had been dusted from 1 to 4 times at 3-week intervals but at staggered starting and completion dates.

Plots were sampled weekly by shaking loose fruit from intact bunches. These samples were checked by cutting 100 fruit from each plot for records on the percentage of insect infestation. Each plot was also picked at harvest time, and conventional packing house grades were made. Malathion dust application dates and the results are in Table 1.

TABLE 1. Results of 5% malathion dust applied from 1 to 4 times at 3-week intervals on 2 Deglet Noor date groves for the control of insects infesting dates.

Plot	Dusting Date								% Fruit Infested		
No.	8-15	8-29	9-05	9-19	9-26	10-10	10-17	10-30	Weekly [a]	Harvest [b]	Culls [c]
1	x					x[d]			11.8	5	29
2	x					x[d]			12.2	3	13
3	x		x						5.2	1	22
4	x		x						9.6	2	13
5	x		x		x				2.9	3	24
6	x		x		x				14.3	2	16
7	x		x		x		x		3.3	0	17
8	x		x		x		x		3.2	3	16
9						x[d]			12.0	5	20
10						x[d]			15.0	3	13
11		x							4.9	4	19
12		x							9.9	4	21
13		x		x					3.6	1	12
14		x		x					4.1	3	17
15		x		x		x			2.3	0	16
16		x		x		x			4.4	3	24
17		x		x		x		x	3.6	1	20
18		x		x		x		x	4.4	1	30

[a] Weekly = average percentage of insect-infested fruit from 11 weekly samples taken from intact bunches.

[b] Harvest = packing house harvest sample: percentage insect-infested fruits.

[c] Culls = packing house harvest sample: percentage of all cull fruit including insect-infested, nonpollinated, moldy, dirty, and small.

[d] Severe infestations that were dusted out of schedule to prevent further losses.

[1] Elmer, H. S. 1967. Malathion, a factor in date harvesting. Date Growers' Inst. Ann. Rep. 44:7-8.

The results from the weekly samples were variable and probably did not accurately show the effects of the malathion dust applications in reducing infestation throughout the season. The same palms were not sampled each week since, once the loose fruit was shaken out of a particular group of palms, no loose fruit was available for a few weeks for subsequent samples. Table 1, however, shows the average of all 11 weekly samples. Except for plot 5, the percentage of infestation decreased as more dust applications were used. A minimum of 2 dust applications 3 weeks apart, with the first applied August 29 (plots 13 and 14) was effective in keeping the infestation level below 5%, generally considered the maximum infestation that can be economically handled in date packing houses in the Coachella Valley of California.

Malathion dust plots were also established in one date garden where the bunches were low and could be easily dusted and checked from the ground. A series of replicated plots was dusted once with 5% malathion starting August 22, and other replicated plots had 2 dusts at different times. Because of the ease in directing all of the dust under the paper covers, less than 20 pounds of dust per acre was applied. Untreated palms were also left for check plots. The results are shown in Table 2.

All the dusted plots remained free of insect infestation for the duration of the test (approximately one month). Because these plots were harvested the first week in November, additional longevity tests were not feasible; no harvest records were made. Comparison of the dusted plots with the untreated checks, however, shows the advantages of this type of dusting.

At weekly intervals strands of dates having from 10 to 15 fruit which had been dusted with 5% malathion on August 22 were cut from intact bunches. Non-dusted strands were also cut from check bunches at the same time. These strands were placed in cages with pumpkin added for a food source and 2 species of nitidulid beetles were introduced into the cages each week. The results are shown in Table 3. All 20 adult beetles introduced each week were killed on the dusted date strands for 6 weeks following the dusting. Approximately ½ the beetles were killed following the eighth week, while all beetles survived on the non-dusted dates for the test duration.

TABLE 2. Results of 5% malathion dust applied 1 or 2 times on Deglet Noor dates for the control of date-infesting insects

Fruit [a] examined	Avg. % fruit infested on plots dusted [b] 8-22	9-4	8-22 9-19	9-4 9-19	9-19	Control
9-6	0	3.4	3.7	0	3.1	4.1
9-27	0	0	0	0	0	16.2
10-3	0	0	0	0	0	18.4
10-24	0	0	0	0	0	7.4

[a] 50 fruit from each replicate were cut open for infestation percentage.
[b] Average percent of infestation from 3 replicate plots.

The packing house infestation percentages reached the 5% level only in plots 1 and 9. These 2 plots and also plots 2 and 10 were dusted out of schedule on October 10 because the weekly counts indicated an infestation level that could cause a serious loss. The low percentage of infestation at harvest time may have been due to the weekly removal of loose fruit, those most likely to be infested.

TABLE 3. Number of weeks that a 5% malathion dust killed nitidulid beetles.[a]

Weeks after dusting	No. live (L) and dead (D) beetles: Dusted	Nondusted	Control [b]
1st	20 D	20 L	20 L
2nd	20 D	18 L 2 D	20 L
3rd	20 D	20 L	20 L
4th	20 D	20 L	20 L
5th	20 D	20 L	20 L
6th	20 D	20 L	20 L
7th	18 D 2 L	20 L	20 L
8th	9 D 11 L	20 L	20 L
9th	0 D 20 L	20 L	20 L

[a] Dusted August 22; date strands placed in cages and 20 beetles introduced each week.
[b] Control — cages with beetle food source and no date strands.

Summary. Insect infestations of date fruit can be reduced below the economic level by the use of malathion dusts applied at least twice during the ripening period with available dusting equipment. Dusting should be done earlier in the fruit-ripening stage than many growers now dust, but not too early or the toxicity will be gone before the appearance of the beetles. For the best protection, with the minimum amount of dust per acre, each bunch should be dusted thoroughly but separately. While this is probably not practicable in commercial applications, particularly in tall palms, it might reduce expense, since fewer applications would be necessary.

Malathion evidently remains toxic enough to kill nitidulid beetles from 6 to 8 weeks. Growers should time the treatments according to the movement of insect reinfestations.

THE PRESENT CONDITION OF WORLD DATE CULTURE

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1. World Production of Dates

Statistics on date palms, their yield, and date consumption are scanty, difficult to collect and unreliable.

TABLE 1. Estimated global number of date palms and date production

Country	Millions of palms (including males and non-bearing females)	Avg yield a palm (including males and non-bearing females) in kg	Total Production 1,000 tons	% of World total
U.A.R	13	30	404	22
Iraq	30	12	354	19
Iran	20	15	302	17
Saudi Arabia	8	30	240	13
Algeria	4	25	105	6
Other Countries	21	20	421	23
Total	96	22	1,826	100

The estimate of production (Table 1) has been largely compiled from the FAO *Production Yearbook* for 1966 and with the kind help of correspondents in several countries.

If the production figures are correct, 12kg a palm appears low for the Iraqi average, but, if it be raised, then either the number of palms is less than the widely quoted 30 million, or the total production is still higher than the frequently quoted 350,000 tons. Similarly in Iran, the production figure may be too low or the number of palms too high.

Thirty kg a palm appears reasonable for Saudi Arabia and the U.A.R., where much of the crop is consumed in the early, heavy stages.

2. Exports of Dates from Producing Countries

Table 2, compiled from FAO's *Trade Yearbook*, 1966, shows the average exports of dates for the six years 1960 to 1965. The figures in Tables 1 and 2 indicate that exports are 17% of production.

TABLE 2. Date exports 1960-1965

Exporting Country	1,000 tons	%
Iraq	261	82
Iran	26	8
Algeria	21	7
Saudi Arabia	3	1
Tunisia	3	1
U.S.A.	3	1
Total	317	100

3. Imports of Dates

TABLE 3. Average annual imports of dates into the principal importing countries (1960-1965)[1]

Country	1,000 tons	% total
China	50	16
India	45	14
Syria	25	8
France	20	6
Arab States (Gulf)	18	6
U.S.A.	17	5
U.S.S.R.[2]	15	5
U.K.	13	4
Ceylon	9	3
W. Germany	9	3
E. Germany	7	2
Italy	5	1
Others	92	27
Total	325	100

[1] Compiled from FAO's *Trade Yearbook*.

[2] Iraq reports considerably increased exports to the U.S.S.R. the last two seasons.

4. Changing Food Habits

In Saudi Arabia there may be clearly observed the impact of changing food habits on the date industry; but there has been a similar change in food habits in many countries, especially in the industrialized ones. Modern techniques of transport and storage have decreased dependence on the traditional dried fruits, including dates.

The figures in Section 15, below, for gross imports of dates into the United Kingdom over the past 20 years show clearly the drop in date consumption.

5. United Arab Republic

Iraq is widely believed to be the largest date producer in the world, but the official figure for the average production of dates in the U.A.R. for the 6 years 1961 to 1966 is 404,000 tons, while the average for Iraq for the 5 years 1961 to 1965 is only 354,000 tons (for 1961 to 1964 official figures, for 1965 non-official). On the other hand, Iraq is the world's biggest exporter of dates, whereas the U.A.R. exported only an average of a little more than 200 tons over the last 11 years. Not only is the U.A.R. the biggest date producer, but it also imports a considerable quantity. The average imports for the 4 years 1964 to 1967 were 8,000 tons.

The net annual consumption of dates in the U.A.R. is thus about 412,000 tons. As the population of the U.A.R. is considered to be about 26,200,000, the average consumption of dates a head a day would thus amount to only about 5 dates, or less if the dates are consumed in the heavy, early stages. As the population of the U.A.R. is largely agricultural and dates are a favorite food, there seems no reason to doubt the accuracy of the very high figure for production and the very low one for export.

A great deal of the crop, especially in the Delta, is eaten fresh in the *khalaal (bisir* or *laun)* stage.

Methods of date culture have changed little in recent years. Government attention has been directed to grain production, for which the new irrigation works are chiefly designed, to feed the rapidly increasing population. The new regime of the Nile, which last season, for the first time in recorded history, did not flood the country, may be expected, however, to improve date production.

In the U.A.R. production of fancy date packs has never progressed very far.

6. Iraq

a. Production

Iraq continues to be by far the greatest exporter of dates in the world. The number of date palms in that country is generally quoted as about 30,000,000, but the number may be less for new planting is probably not making up for losses. Government publications give the

yield as about 350,000 tons, of 12 kg a palm, or, if about ¼ are males or females not bearing, the average yield of bearing females would be about 15 kg.

b. **Political Change**

Military dictatorships with leanings to communism have followed the murder of the King in 1958, and agriculture, industry and trade since then have been for the most part controlled by Government. Little scope is left for private enterprise. Military officers with little experience in agriculture, industry or trade are in charge of all departments. The consequence has been unfavorable for dates, because growers have been putting less money back into their gardens than they used to do.

c. **Single Buyer**

Another reason for the reduction in the profits of date growing has been the substitution of a single buyer, that is, the Government-controlled Date Association, for a number of independent date merchants, whose competition formerly maintained the price at the highest level the market would stand. On the other hand, with the Iraqi Date Trading Co., the only Iraqi seller on the world market, the sale price abroad can be kept steady, with no undercutting. However, flat purchase prices for each of the 3 main varieties and for all other varieties lumped together have caused a lowering of quality of dates brought to packing-houses, for there is now less care in the gardens to keep the different grades separate. Also the Government agent who receives the dates tends to be less strict than the agents of competing export merchants used to be.

The I.D.T. Co. have good agents in London and New York, who are permitted to pay immediate compensation to buyers who find consignments not up to specification. This gives Iraq a considerable advantage over her chief rival, Iran, in the European and American markets. Growers, however, complain of long delays, sometimes many months, or even a year, between delivery of their dates and receipt of payment.

d. **Price**

Last year Government bought Zahidi dates for the manufacture of date syrup at \$22.40 a ton and for export as dates at \$40. Prices for Khadhraawi and Ista'amraan were \$67.20 and for Hallaawi \$78.40. Because of the Government policy of paying only one price for all grades of fruit within the variety, the Iraqi Date Trading Co. receives an annual subsidy of about \$1,190,000 at the present rate of exchange. A price of \$67.20 a ton is the equivalent of 3½c a pound.

e. **Markets**

Although world demand for dates appears less, two large new markets have been found recently for Iraq. These are Russia and China. With India and Syria, these are the biggest markets, but the quality of dates sent to them is poor and the price low. The Euphrates Zahidi form a large part of these consignments. The more profitable markets are those of the U.S.A. and the U.K.

f. **Packing Houses**

Large and expensive date packing houses have been built by Government and equipped with heavy Russian machinery; but it is doubtful that they give a satisfactory return on the capital invested. Probably, in the present state of the world market, for a cheap and seasonal crop like dates, more modest installations, but more modern than the old temporary, reed-mat packing stations, are required. Private packers are allowed to operate in Basrah, but their export product is handled by the Government exporting agency. Altogether there are a little over 80 private packing houses on the Shatt-el-Arab; but a prospective packer must satisfy the Government inspectors that his packing house is of permanent construction, has a cement floor, and is provided with running water. There is no machinery in these 80 odd packing houses.

g. **Labour and Cultivation**

Methods of date cultivation in Iraq have changed little. Labour is still cheap compared, for example, with the price in Saudi Arabia, and there has been little or no mechanization in the date gardens beyond a large number of pumping plants for irrigation.

h. **Date Syrup**

The Government factory in Baghdad for brown date syrup is stated to have capacity of 12 tons of syrup in 8 hours, but production seems to be under 1,000 tons a year. Two new factories have been proposed for the total production of 10,000 tons of date syrup, some of it colourless for the soft drink and confectionery trade and using low-quality Zahidi at around \$18.20 a ton.

i. **Hard-Board**

A factory has also been proposed for the manufacture of hard-board from date trunks, fronds, frond bases and stalks of the fruit bunches. Preliminary experiments are said to have shown that a hard-board can be produced in Iraq from these materials at a price and quality competitive with imported board.

7. **Iran**

a. **Production**

There are probably about 20,000,000 date palms in Iran, the third biggest producer of dates in the world. These palms occupy, perhaps, 2% of the cultivated land, or 0.07% of the area of the whole country. The total yield may be about 300,000 tons.

b. **Culture**

The culture of the date palm has changed but little, except in irrigation, for which pumps have replaced to a considerable extent the former hand or animal hoists. Though the introduction into Iran of a large number of tractors has greatly altered the technique of cultivation of many crops, they have not yet penetrated the date gardens. Labour is still plentiful and comparatively cheap in the many and widely scattered date oases in the enormous area of southern Iran, but has become expensive in the neighbourhood of the oil installations in the Abadan district and of the bigger towns.

c. **New Planting**

There has been considerable new planting of date palms on Abadan Island, between Abadan and the sea, because Government have allowed growers on the left bank of the Shatt-el-Arab to plant up the desert between their gardens and the north-south road. Such land, when planted to dates, is then considered the private property of the person owning the garden between it and the river.

d. **Markets**

The 24 million Iranis provide the chief market for the local dates, but there is a growing export to Russia through Tabriz. Export to the U.S.A., Canada, Australia, W. Germany, Holland and S. Africa is from Khurramshahr, on the Shatt-el-Arab at the head of the Persian Gulf, and from Khurramshahr and Irani Gulf ports to the Arab ports on the Gulf and to the E. Coast of Africa.

Iran suffers less than Iraq from the reduced world demand for dates, because, while the inhabitants of both countries are date eaters, yet Iran's population is three times that of Iraq, while her date production is about a seventh less than that of her neighbour.

e. **Export**

Some of the difficulties date growers in Iraq have suffered have not been felt in Iran, but the export trade has also suffered from a reduced world demand. The price last season in Khurramshahr, where the exporters have their packing houses, was 300 Irani riyals for a *mann* of 75 kg of Ista'amraan (Sayir), the equivalent of \$53 a ton, which was even less than the Iraqi price. Further-

more, the exports were about $\frac{1}{3}$ less than those of the previous season. The reduction appears to have been due to (1) Iraq's announcement well in advance of last season that she would guarantee her prices against decline by Iran. Previously Iraq had maintained fixed prices in all markets and had thereby allowed Iran to capture more exports by undercutting Iraq's prices; (2) Iran's lack of funds abroad with which to settle hona-fide claims of buyers. Iraq settles such claims promptly from funds deposited with the Rafidain Bank, London, which are availahle also in other markets through that hank's agents abroad; (3) Iran's insufficiently rigorous grading for quality and elimination of dirt. Recently London retailers have been receiving many complaints about the poor quality of Irani packs.

The highest export of dates in any one year recorded officially was 48,000 tons in 1947; the present export is only about $\frac{1}{2}$ that.

f. **Bam**

In Khurramshahr, from which there is the only large export of dates, all the 7 packing houses are privately owned; but, through the Industrial Credit Bank, Government is contributing to the cost of a new date packing-house at Bam in southern Iran, the home of the magnificent Muzaafti date. The other shareholders are the big landlords in the neighbourhood.

The equipping of this packing house has caused considerable discussion. As the Muzaafti is especially in demand as a soft date, a nitrogen pack has been proposed.

g. **Boiled Dates**

The important export trade in dates which have been boiled while in the yellow, hard, glossy stage and dried in the sun (and then known as *khalaal matbuukh* in Iraq, *saluuq* in Saudi Arabia, and *khaarak pukhteh* in Iran) has dwindled to a small amount, for Pakistan and India, which were the chief markets for these dates, grant licenses for the import of only small quantities, owing to their wish to conserve foreign exchange.

8. **Saudi Arabia**

a. **Number of Palms**

Saudi Arabia is probably the fourth greatest producer of dates in the world. The numher of her date palms, variously estimated at from 5 to 8 million, is prohably near the higher estimate.

b. **Production**

If the total number of palms is about 8,000,000, and $\frac{1}{4}$ are males or females not yet of bearing age or adult, non-bearing females, the numher of bearing palms in any one year would be about 6,000,000. The yield a palm is probably higher than in Iraq, especially since in Saudi Arabia a large part of the crop is harvested in the heavy, fresh stage. An average for Saudi Arabia of 40 kg a bearing palm is probably not too high. This would give a total production of about 240,000 tons. Exports, chiefly to the Gulf ports by local craft, are around 3,000 tons. Just as in Iraq and Iran, the export of saluuq from Saudi Aradia is now much less than formerly. The import of dates into Saudi Arabia was prohihited, but the ban has been raised recently, it is said at the request of Iraq.

c. **Price**

The market price of dates can be as high as Riyals 3 a kg, the equivalent of $0.67, which was heing paid for Barhi in the Qasim last season. At the other end of the scale, at Qatif, at the heginning of the season, the poorest quality Khuneizi were selling in haskets at Rls 4 for 32 kg gross, or 3c a kg. Perhaps the average market price of dates for the countrv the year round is ahout $\frac{1}{2}$ Rl a kg, that is, about 11c.

d. **Capital Value of the Date Palm**

If the production of dates in Saudi Arabia is about 240,000 tons a year and the average price is $\frac{1}{2}$ Rl a kg, the value of the annual Saudi crop would he Rls 120,000,000, that is nearly $27,000,000. It is reasonable to set the capital value of the palms at 10 times the value of the annual production. Then the capital value of the date palms of Saudi Arahia would amount to Rls 1,200,000,000 (nearly $267,000,000). One probably ought to add the value of the yearly production of the dried fronds for building, fencing and fuel. At $\frac{1}{2}$ Rl a palm a year, this adds another Rls 40,000,000.

e. **Rapid Change in the Food Habits of the Population**

Saudi Arabia at the present time is, perhaps, the most interesting of the date-growing countries, for here at work, more rapidly and more strongly than anywhere else, are the forces of change from time-honoured practice to the modern world.

In 30 years a population whose staple food from time immemorial had heen dates and camel's milk, a little grain and, round the coasts, a little fish, is now importing yearly more than $100,000,000 worth of food, including frozen meat, canned goods, fresh fruit and the ingredients for making Pepsi-Cola. All imported food is free of customs duty, and, in addition, on 2 or 3 foods Government subsidizes the importer. Formerly one of the poorest countries of the world, Saudi Arahia now has an annual hudget of around a billion dollars from the vast revenues which now accrue to Government from the Arabian-American Oil Company, whose production of oil amounts to 130,000,000 tons a year.

Following the drilling for oil came the drilling for water and with such success that agriculture and horticulture now flourish in a number of places that were desert.

In the towns there is a large and increasing demand for fresh fruit, vegetables and fodder; and the growing of these is now more profitahle than the growing of dates. However, in most new vegetable, fodder and fruit gardens, date shoots continue to be planted. The date palm, which, with the camel, has been for so long the support of the dweller in the desert, is still regarded as an insurance; and the cultivator and his family still look to the date palm to provide them with much of their food from the end of June, when the earliest dates are ripe enough to eat, to December, when the latest varieties are still bearing. The date palm, furthermore, although able to withstand a considerable amount of flooding, is one of the most drought-resistant of crops and will survive when the cultivator's other crops, in years of no rainfall, have failed.

Market gardening in Saudi Arabia is likely to become less profitable than it now is owing to the continually increasing area devoted to it within the country and to the probability that other Near-Eastern countries, notably Jordan, will he greatly enlarging their production and exports within the next few years.

f. **Consumption of Dates**

It appears to he widely believed that, with the enormous increase in the import of foreign food into Saudi Arabia in recent years and the considerable reduction in the permitted import of Saudi dates into the Indian peninsula, the demand for dates in Saudi Arabia has decreased. On the other hand, though here and there in some badly kept gardens of miserable palms there has recently been no pollination and therefore no crop, yet nowhere in the country do dates seem to he thrown away or allowed to rot on the bunch. However, in recent years, the price of dates in the country has not risen in line with that of most things, in particular with that of lahour.

Possibly a greater proportion of the crop is consumed by domestic animals than formely, and also the recent increase in population, especially by the immigration of date eaters from the Yemen, the Hadhramaut, Uman and the Gulf states, may have heen partly responsible for maintaining total consumption at its usual level. The people of Saudi Arahia are better fed than they used to be, and prohably at least outside the big towns, they are eating the imported food in addition to, not instead of, dates.

Dates, formerly the staple food of all, are now more the food of the poor. They remain a widespread and valuable food for farm animals, however, for though they usually cost a little more than green alfalfa, they are ¾ nourishment, while alfalfa is ¾ water.

g. Consumption of Dates per Head

The population of the country is about 4,000,000, of whom 1,000,000 to 1,500,000 are considered to be urban and 2,500,000 to 3,000,000 non-urban. If so, and if ¼ of the crop is fed to farm animals, then the average consumption of dates a person would be about 45 kg a year, say 134 g a day or about 15 dates. The countryman presumably eats more than this and the townsman less.

A recent survey of the household expenditure of Arabian American Oil Co., lower-grade, Saudi employees showed that they spent less than 2% of their average annual pay of Rls 12,760 ($2,835) on dates. If their average buying price were Rls 0.75 a kg, the annual consumption of a family of 5 persons would thus amount to something less than 340 kg a year, or to less than 23 dates a day a head.

h. High Cost of Labour

Not only does the date cultivator have to sustain the competition of immense quantities of imported food, but even more serious is the high cost of agricultural labour, especially of persons able, or willing, to climb palms. Like some of the Berber landlords in Libya, the Najdi Badui who has acquired rights to a new artesian well and has planted date palms but has not learned to climb them has to engage villagers to climb and such villagers are sometimes paid as much as $7.77 with free lunch and morning coffee for half a day's work. The ordinary agricultural labourer working on the ground is paid $2.22 for a whole day; and women sorting dates in the Qasim last season were receiving $1.33 each for 4 hours' work. However, at Layla this spring, pollinators are being paid $4.89, while men working on the ground in the date gardens receive $3.78.

9. Algeria

The disruption of the economy by internal war, the replacement of the French regime by one with strongly communist leanings and the repatriation of all French citizens have resulted in great deterioration in date gardens and closing of packing-houses. The populace now lives mostly on the oil revenues. France, however, continues to give aid to Algeria and takes 93% of the Algerian export of 25,000 tons of Daqlat Nuur. (Deglet Noor).

10. Tunisia

Tunisia has suffered much less than Algeria from the change to autonomy and the condition of the date gardens has deteriorated less. Exports over the 6 years 1960 to 1965 averaged 3,000 tons, mostly to Marseilles, but there is a little local packing for export, mostly to Italy.

11. Morocco

In the 19th Century Morocco had more date palms than inhabitants. The number of palms was then 15,000,000; but in 1898 there first appeared the Beiyuudh (Bayoud) disease, caused by the fungus *Fusarium oxysporum,* Schlecht. var. *albedinis* (Killian and Maire) Malencon. By 1930 nearly 2/3 of the date palms had succumbed. By 1950 only 5,000,000 were left; and by 1960 the number alive was estimated to be only 4,500,000. Of these 30% were estimated to be fatally infected. There is no remedy; but M. Toutain is working at Marrakech on propagation of resistant varieties. Unless resistant varieties can be propagated quickly enough, the date groves of Morocco will disappear.

The writer is much indebted to M. Jean Cazautets of PRAM for the information above.

12. The United States of America

a. World Benefit from Small U. S. Plantings

The U.S.A. has probably not more than 1,800 ha. of date palms, with an annual production of about 20,000 tons, but, nevertheless, has probably contributed more to the development of scientific date production and date products than any other date-growing country in the world, and, furthermore, despite its very high cost of labour, it has even managed recently to establish an export trade.

Apparently the survival of the industry, despite the handicap of the choice of the climatically fastidious Daqlat Nuur as the principal variety, is due to the courage, hard work and persistence of the pioneers, the excellent scientific aid given by the U.S.D.A., the amelioration of the Coachella Valley water supply, the control of pests (notably the extermination of the *Parlatoria* scale), the proper use of fertilizers, the mechanization of production, harvesting and packing, the development of outlets such as date bread, and the imposition of a duty on imported dates.

However, the quantity of dates produced in the country is not enough for its needs, so that, between 1903 and 1967 the U.S.A. imported an average of 17,000 tons. This country is thus the world's sixth biggest buyer.

b. Imports

Table 4 shows that, whereas before World War II Iraq supplied almost all the date imports of the U.S.A., since then the proportion supplied by Iraq has steadily declined and Iran now supplies nearly ½ of the U.S. overseas requirements. The change is remarkable in that the producing districts are adjacent, use the same river and grow the same varieties. Furthermore, Irani dates used to be considered inferior to those of Iraq because they were grown nearer the sea and, therefore, perhaps suffered rather more from salinity. Some merchants have said that the change is due to the more favorable political climate in Iran than in the neighbouring state.

Table 4 also shows that gross imports of foreign dates into the U.S.A. in the past 30 years have declined 26%.

Re-exports in 1965 amounted to only 238 tons, while the exports of Californian dates rose to 3,405 metric tons, West Germany being the principal buyer.

c. Consumption a Head

In the last 2 years (1965-1966 and 1966-1967) the average net import of dates into the U.S.A. was 11,000 tons. Californian production was perhaps 20,000 tons, so that the total consumption of dates in the country was about 31,000 tons. This quantity gives an annual consumption a head of 155 g, less than ½ a g a day, or one date every 3 weeks.

TABLE 4. Gross imports of dates into the U.S.A. to nearest 1,000 tons.

5-Year Average	From Iran	From Iraq	Total	% from Iraq
1934—1938	23	0.28	23	99
1951—1955	19	1	20	95
1955—1959	17	3	20	85
1958—1962	12	5	17	71
1963—1967	10	7	17	59

13. France

France imports no Iraqi dates, but the import of the Daqlat Nuur from Algeria and Tunisia (about 1,000 tons) has remained steady over the years 1960 to 1965 at 20,000 tons. Half of this quantity is packed in glove boxes and shipped abroad, mostly to the United Kingdom and the rest of Europe. The British import from France dropped from an annual average of 4,300 tons for the decade 1946 to 1955 to an annual average of 3,600 tons for the decade 1956 to 1965, a drop of only 16%. This compares with the drop of 73% in the British imports from Iraq in the same period. Demand for the glove-box pack remains much firmer than that for the Iraqi bulk-box pack.

14. India

Figures for the import of dates into India given in the FAO *Trade Yearbook* differ from those received from India, but the quantity may well be around 45,000 tons, with Iraq supplying 89%. The landed value of the 1966 crop was about $100 a ton in baskets.

India and China are now the biggest importers of dates in the world.

15. The United Kingdom

The U.K. has been importing dates from North Africa and the Persian Gulf for hundreds of years, but the peak in the modern trade was probably reached between the two world wars. Since World War II, date imports into the U.K. have declined as shown by the following:

Average imports of dates — 1946-1955	26,000 tons
Average imports of dates — 1956-1965	14,000 tons

Imports for the second decade were only 48% of those for the first decade. Presumably the primary cause of this big drop is a change in the food habits of the British, but it is to be remarked that the imports from N. Africa (via France) dropped only 20% during the same period and that the imports from Iran rose in the same period from 300 tons in 1955 to nearly 4,000 in 1967. The Iraqi imports dropped 75%.

16. Italy

Italy's annual import of 5,000 tons of dates is mostly made up of baskets of Zahidi from Iraq for distilling and between 500 and 1,000 tons of glove-boxed Daqlat Nuur from Tunis.

17. Price

The average landed price of dates imported into the U.K. for the decade 1946 to 1955 was £87 a ton. For the following decade it was £122, a rise of 40%.

The average F.O.B. Basrah price of Iraqi dates a ton for the 8 years 1950 to 1957 was £16 and for the following 8 years £20, a rise of 25%.

The average New York spot price for Iraqi dates (Ista'amraan, *i.e.* Sayir) for the 5 years 1956 to 1960 was $330 a ton, while for the following 5 years the price averaged $366 a ton, a rise of 11%.

18. Conclusion

Above, an attempt has been made to estimate the quantity of dates produced in the world, the quantity that enters into trade between countries and the general trends of that trade. The conclusion reached is that it is the cheaper markets that are expanding and the dearer ones contracting. Date growing in the Old World may, therefore, be expected to become less profitable than formerly, if it continues to be carried out as at present. To enable it to remain profitable it is suggested that labour must be made more productive by increased mechanization and that packing and presentation must be improved.

CHEMICAL TESTS FOR THINNING MEDJOOL DATES

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Recently attempts have been made to lower the cost of thinning the fruit of Medjool date palm, *Phoenix dactylifera* L., by using chemicals. Furr and Hewitt (1) reported that it may be possible to use 2,4,5 trichlorophenoxy acetic acid (2,4,5-T), napthaleneacetic acid (NAA), and dinitro-ortho-secondary-butylephenol (DNBP). Ketchie (2) indicated possible use of 2,4 dichlorophenoxy acetic acid (2,4-D), napthalene acetamide (NAAm) and gibberellic acid (GA_3). The purpose of the present work was to investigate further the use of the 6 materials and to try an additional material, mono (armeen dimethyl coco-amine) succinate (MS).

MATERIALS AND METHODS

Seven chemicals were tested in 1967 in a block of 49 Medjool palms at the U.S. Date and Citrus Station, Indio, California. They were applied 1, 2 and 3 weeks after the opening of the spathe at the following concentrations: 3000 parts per million (ppm) DNBP; 20 and 50 ppm 2,4-D; 20, 75 and 500 ppm 2,4,5-T; 50 ppm NAA; and 400, 4000 and 8000 ppm MS. GA_3 was applied at 25, 50 and 100 ppm at the time of pollination. There were 6 replications, consisting of 1 bunch on each of 6 different trees. The materials were applied to the bunches with a pressure-type hand sprayer. At the time of pollination, all treated bunches were thinned to 40 strands. There were two types of checks: (a) 1 bunch on every palm that had a treated bunch was thinned to 20 to 30 fruit per strand (noted as hand-thinned in the tables); and (b) 1 bunch was thinned to 40 strands but no fruit was thinned from the strands (noted as check in the tables).

The mature fruit was harvested once a week. On the sixth harvest date, the bunches were stripped of mature and immature fruit.

RESULTS AND CONCLUSIONS

Bunches treated with 400, 4000, and 8000 ppm MS one week after pollination; 8000 ppm MS and 50 ppm 2,4-D two weeks after pollination; 500 ppm 2,4,5-T three weeks after pollination; or 50 and 100 ppm GA_3 at time of pollination had fruit as large or larger than the hand-thinned bunches (Table 1). Bunches that were sprayed with 8000 ppm MS two weeks after pollination had a higber yield than those under other treatments.

Bunches in treatments not appearing in Table 1 had smaller fruit than those under the hand-thinned treatment.

Applications of 8000 ppm MS and 50 ppm 2,4-D two weeks after pollination and 500 ppm 2,4,5-T delayed maturity of the fruit (Table 2). It was doubtful that the fruit sprayed with 2,4,5-T that was not mature at harvest would have ever matured. Bunches sprayed with 400 ppm MS one week after pollination and 100 ppm GA_3 at time of pollination had an earlier maturity date than the hand-thinned bunches. Maturity dates of the other treatments were comparable to the hand-thinned treatment. A comparison of hand-thinned bunches with the checks, which were only thinned

TABLE 1. The effect of various chemicals on size of fruit and weight per bunch of Medjool dates

Treatment	Concentration	Weeks after pollination treatment applied	Avg weight per bunch	Avg fruit per lb.
	(ppm)	(no.)	(lb.)	(no.)
MS	400	1	19 bc[1]	20 b[1]
	4000	1	15 c	20 b
	8000	1	15 c	17 a
	8000	2	26 a	19 b
2, 4-D	50	2	19 bc	20 b
2, 4, 5-T	500	3	13 c	20 b
GA_3	50	0	17 b	18 ab
	100	0	22 b	18 ab
Check[2]			18 bc	22 c
Hand-thinned[3]		8	17 bc	20 b

[1] Treatments having different letters are significantly different at the 5% level of probability.

[2] Check bunches were thinned to 40 strands, the same as all treated bunches.

[3] Hand-thinned bunches were thinned to 40 strands and the fruit was thinned to 20-30 fruits per strand.

TABLE 2. The effect of various chemicals on the maturity of Medjool dates

Treatment	Concentration	Weeks after pollination treatment applied	Days after pollination that fruit reached maturity						
			180	187	194	201	208	222	Khalal[1]
	(ppm)	(no.)	%	%	%	%	%	%	%
MS	400	1	25	19	22	22	8	3	1
	4000	1	13	12	20	30	14	6	5
	8000	1	19	23	27	21	7	1	2
	8000	2	7	11	10	20	17	19	16
2, 4-D	50	2	7	11	17	33	17	11	4
2, 4, 5-T	500	3	4	10	9	15	16	29	17
GA_3	50	0	19	26	24	21	7	2	1
	100	0	21	28	25	20	4	1	1
Check[2]			21	22	20	19	8	7	3
Hand-thinned[3]		8	18	18	24	23	7	5	5

[1] Fruit that remained in the khalal stage after 222 days.

[2] Check bunches were thinned to 40 strands, the same as all treated bunches.

[3] Hand-thinned bunches were thinned to 40 strands and the fruit was thinned to 20-30 fruits per strand.

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to 40 strands, indicated that hand-thinning delayed maturity.

Regardless of treatment, the largest fruit was picked on the third and fourth harvest dates (Table 3).

In general, 100 ppm GA_3 applied at the time of pollination was the best treatment because it not only produced yields and fruit size equal to the hand-thinned bunches but it can be applied when the bunches are pollinated. Also, the GA_3 treatment hastened maturity.

SUMMARY

Seven chemicals were applied to Medjool date bunches at various concentrations at the time of pollination and 1, 2 and 3 weeks after pollination to test their effectiveness as fruit thinners.

Applications of 400, 4000, and 8000 ppm MS one week after pollination, 8000 ppm MS and 50 ppm 2,4-D two weeks after pollination, 500 ppm 2,4,5-T three weeks after pollination, and 50 and 100 ppm GA_3 at the time of pollination thinned the fruit without decreasing the weight per bunch below that of the hand-thinned. Bunches sprayed with 8000 ppm MS weighed more than hand-thinned bunches.

Fruit on bunches sprayed with 400 ppm MS one week after pollination and 100 ppm GA_3 at the time of pollination matured earlier than the fruit on hand-thinned bunches. Applications of 8000 ppm MS and 50 ppm 2,4-D two weeks after pollination and 500 ppm 2,4,5-T three weeks after pollination delayed maturity as compared to hand-thinned bunches.

Regardless of the treatment, the largest fruit was harvested during the mid-harvest period.

TABLE 3. Size of Medjool dates at different dates of maturity

Treatment	Concentration	Weeks after pollination treatment applied	Days after pollination that fruit reached maturity 180	187	194	201	208	222
	(ppm)	(no.)	(fruit/lb.)					
MS	400	1	23	20	20	18	21	27
	4000	1	20	22	22	19	19	21
	8000	1	17	19	17	16	17	21
	8000	2	22	21	20	18	18	19
2, 4-D	50	2	22	19	19	18	18	22
2, 4, 5-T	500	3	19	23	20	16	18	18
GA_3	50	0	20	19	17	17	16	17
	100	0	20	19	17	17	16	20
Check [1]			22	21	20	20	20	25
Hand-thinned [2]		8	19	18	17	17	17	25

[1] Check bunches were thinned to 40 strands, the same as all treated bunches.

[2] Hand-thinned bunches were thinned to 40 strands and the fruit was thinned to 20-30 fruits per strand.

LITERATURE CITED

1. Furr, J. R., and A. A. Hewitt. 1964. Thinning trials on 'Medjool' dates — pollen dilution and chemicals. Date Growers' Inst. Rept. 41:17-18.
2. Ketchie, D. O. 1967. Tests of chemicals for thinning and producing seedless Medjool dates. Date Growers' Inst. Rept. 44: 5-6.

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M. B. M. Ranch, Box 833.......Indio
M & R Ranch (D. H. Mitchell), Box 833.......Indio
Marshburn Farms, P.O. Box 242.......Thermal
Marx, Donald, P.O. Box 1478.......Palm Springs
McLain, V. C., Estate, 1420 Seventh St.......Wasco
McLeod, Rose L., 622 Main St.......Lewiston, Idaho
Mitchell Date Gardens, Box 833.......Indio
Moran, Ronald E., 75-740 Hwy. 111.......Palm Desert
Muhs, Arthur B., Box Y.......Palm Springs
Netzley Bros., P.O. Box 343.......La Puente
Newsom, Willis (N & N Ranch), 18251 William Hwy.......Grants Pass, Oregon
Nicoll, R. C. (Valerie Jean Date Shop), 66021 Hwy. 86.......Thermal
Nixon, Roy W., 81-229 Palmyra Ave.......Indio
Oasis View Ranch, 75-475 Desert Park Dr.......Palm Desert
Odlum, Bruce W., Box 787.......Indio

[1]All addresses California unless otherwise specified.

Odlum, Floyd B., P.O. Box FFF....................Indio
Olesen, Kay, P.O. Box 205....................Palm Desert
Olson, Edward O.,
U.S. Date and Citrus Station, 44-455 Clinton, Indio
Oro Del Sol (D. Stevning), 51-064 Monroe........Indio
Patterson, K. K., 81-370 Date Palm Ave............Indio
Peter Rabbit Farms, Box 96........................Coachella
Pierson, Rollins, 7845 Torreyson Dr.......Los Angeles
Pinyan, R. A. and Margaret, 81-710 Miles Ave., Indio
Pixton, Doris I., P. O. Drawer YY..................Indio
Portola Ranch, Box 833..................................Indio
Puls, J. H., Ranch, 72-789 Bel Air Rd., Palm Desert
Rancho Del Rey, Box 833..................................Indio
Rancho El Centro, Box 833...............................Indio
Rancho Ramona (c/o Harboe Mng. Serv.),
P.O. Drawer 1787...Indio
Rancho Sonora (c/o Harboe Mng. Serv.),
P.O. Drawer 1787...Indio
Reuther, Walter, Dept. of Hort. Science,
University of California..............................Riverside
Richardson, H. B., Hort. Science Bldg.,
University of California....................................Davis
Riverside County Agric. Commissioner,
4080 Lemon St...Riverside
Robinson, Donald, U.S. Dept. of Agric.,
45-235 Towne..Indio
Rogers, David A., Rt. 1, Box 271...........Winterhaven
Rummonds Bros., Box 726..............................Thermal
Rutherford, Paul, Rt. 1, Box 73...................Coachella
Rygg, G. L., Box 700......................................Pomona
S & G Ranch (G. K. Ranney),
12550 Brookhurst, Suite J.................Garden Grove
Schmid, Thomas, Rt. 1, Box 35...................Coachella
Schmid, Walter, 7931 Lampson Ave.....Garden Grove
Schmid & Strehle,
7931 Lampson Ave.............................Garden Grove
Schuman Co., 404 N. Roxbury Dr.,
Suite 815 ....Beverly Hills
Schwartzburd, Martin, 11509 Duque Dr...Studio City
Shearer, S. K., 511 Toyopa Dr.........Pacific Palisades
Siemen, Evelyn M., Box 44.....................Palm Desert
Skar Ship Corp., 21 West St............New York, N.Y.
Smead, Paul, P.O. Box 3921...........Karachi, Pakistan
Smigel, George E. Corp., 2017 Granville, Los Angeles
Snow, Dr. Rodney H., 301-20th St.....Santa Monica
Soloro Ranch (W. Murphy), P.O. Box 632, San Jose
Stock, Edward and Pat, Rt. 1, Box 720........Thermal
Swingle, Mrs. Walter T.,
3400 Laguna St.................................San Francisco
Tall Palms Ranch (D. Mitchell), Box 833..........Indio
Thielemeir, Lawrence G., Box 265.............Santa Ana
Urick, W. E. Ranch,
5142 Los Diegos Way.............................Los Angeles
U.S. Date & Citrus Station, 44-455 Clinton St., Indio
Valley Center Ranch,
75-475 Desert Park Dr...........................Palm Desert
Waggoner Bros., Rt. 1, Box 190D.................Thermal
Ward, Edith E. (Dorado Ent. & Project 65),
73-661 Hwy. 111......................................Palm Desert
Watsul Leach Ranch, P.O. Box 86...Rancho Mirage
Webh, Robert W. Jr.,
8 Warm Sands Pl................................Palm Springs
Westerfield, James P., Col., Box 595...............Mecca
Willits & Newcomb, Inc., Rt. 2, Box 72......Thermal
Wilson, Gwyn, 75-075 Hwy. 111................Palm Desert
Winder, Gary, P.O. Box 733..................................Bard
Yost, Leland J., Rt. 2, Box 124........................Thermal
Young, Dr. Forrest O., 460 Marion Rd...... Redlands
Zimmerman Ranch, P.O. Box 124.................Thermal